

## **Political Methodology Comprehensive Examination Requirements**

University of Rochester

The field in political methodology requires students to demonstrate mastery of statistical and econometric concepts and their applications. The knowledge required to pass this field is primarily conveyed in the lectures and reading materials used in the department's graduate-level methods sequence. We recognize the appropriateness of qualitative methods for some research questions, but we emphasize mastery of quantitative methods because we think the same logic of inference applies to both and because mastery of such methods is crucial to understanding and implementing a majority of research projects in political science.

### *Core Courses and Readings*

Students desiring to take the political methodology field exam must successfully complete PSC 505 – Advanced Statistical Methods. The prerequisites for this course include PSC 403 – Mathematical Modeling, PSC 404 – Introduction to Statistical Methods, and PSC 405 – Multivariate Statistical Methods. In rare instances, students with appropriate prior training may obtain permission to skip one or more of the 400-level courses. Because we require students to be exposed to the link between the substance of political science and various research methods, PSC 505 cannot be waived.

### *Additional Methods Courses*

While not required, students who plan to use and teach research methods at advanced levels are also encouraged to complete PSC 406 – Survey Design and Analysis and PSC 506 – Topics in Methods. Students with strong interests in quantitative political methodology are also encouraged to take advanced methodology courses in other departments such as economics.

### *The Field Exam in Political Methodology*

The field exam in political methodology is given each year in January, just after completion of PSC 505, by a committee typically composed of the instructors of the department's methodology courses. Students desiring to take the methodology field exam should contact the instructor from whom they took/are taking PSC 505 to discuss whether the student is prepared to take the exam. Assuming preparedness, students should notify the graduate advisor and the methodology examining committee of their desire to take the exam by December 1 prior to a January. At that time, students must also indicate the primary substantive field in which they plan to apply quantitative methods.

The methodology field exam consists of an eight-hour structured exam in which students solve four statistical problems. Students may use their own notes and reference books to complete the exam. The exam covers the major concepts presented in PSC 404, 405, and 505. A general list of topics and concepts that students must master is attached. We reserve the right to test students (1) on material not

on this list provided that it has been covered in at least one of the department's methods courses and (2) on material on the attached list even if it was not explicitly covered in PSC 404, 405, or 505.

### *Basis of Evaluation*

As a necessary condition for passing the exam, students must show sufficient mastery of the concepts in all of the questions. Necessary (but not sufficient) conditions for passing are that you (1) provide answers to each of the four questions, (2) show understanding of the concepts underlying each question, and (3) show substantial progress in their application toward a correct solution. Students may be asked to rewrite answers to no more than two of the four problems. However, this is only in the case where sufficient progress has been made in those questions. For example, if a student correctly solves two problems, makes substantial progress in the third, but has not made progress or is incorrect in the fourth, then a rewrite will not be offered.

The methods faculty have committed themselves to reading and returning field exams within two weeks. Results will be reported to students as "pass" or "fail" and this overall evaluation will be communicated to students in writing. Each letter will also suggest possible times at which students can meet with the entire examining committee to discuss the specifics of their performances. Students are strongly encouraged to meet with the examining committee for this purpose.

### **General list of topics from PSC 404:**

- Basic probability concepts. Set notation. Sample points and probabilities of events. Conditional probability and independence. Total probability and Bayes rule.
- Discrete and continuous random variables and probability distributions. Expectation, variance, and moments. Special distributions. Tchebysheff's Theorem.
- Bivariate and multivariate distributions. Marginal and conditional distributions. Independent random variables. Conditional expectation. Covariance and correlation. Expectation and variance of linear functions of random variables.
- Sampling distributions related to Normal distribution: Chi-square,  $t$ ,  $F$ . Central limit theorem.
- Estimators, their properties, and methods of estimation. Common point estimators. Large-sample and small-sample confidence intervals. Bias, efficiency, consistency, and mean square error. Sufficiency. Rao-Blackwell theorem. Minimum-variance unbiased estimators. Method of Moments. Maximum likelihood estimators.

- Elements of a statistical test. Type I and II error. Sample size and type II error. Significance levels. Common large-sample and small-sample hypothesis tests. Power of tests. Neyman-Pearson lemma. Likelihood ratio tests. Relationship of hypothesis tests to confidence intervals.
- Research Design. Threats to internal and external validity. Experimental designs. Quasi-experimental designs. Non-experimental designs. Analysis of variance.
- Analysis of Categorical Data. Chi-square test. Goodness of fit test. Contingency tables. Controlling for intervening variables. Measures of association.

#### **General list of topics from PSC 405:**

- Properties of estimators – bias, precision, efficiency, BLUEness, consistency, robustness
- Basic OLS model and assumptions – common functional forms, consequences of violation of assumptions for OLS, diagnosing violations of assumptions, relationship to non-linear estimation
- MLE – properties, relationship to OLS with normality assumption
- Hypothesis testing in OLS context – Normal, Chi-square, Student's t, and F distributions, tests of individual coefficients and goodness of fit, compound linear hypotheses and confidence intervals for predictions, simultaneous hypotheses and confidence regions, diagnostic tests based on F, Chow tests, heteroscedascity tests, etc.
- Basic GLS – basic results, feasible GLS as applied to AR1 models, White standard errors as alternative to FGLS
- Discrete dependent variables – group- and individual-level logit and probit, censoring of Normal distributions and tobit
- Basics of simultaneous equations – reduced form equations, identification (overview), instrumental variables, 2SLS, some 3SLS and its use in SUR

#### **General list of topics from PSC 505: (Students must master theory and practice.)**

- Establishing properties of OLS estimator -- linear projections, law of iterated expectations, OLS under “ideal” conditions, conditional expectation, “fixed in repeated samples” concept, fixed X, stochastic X, independence, mean independence, uncorrelated, convergence in probability,

Slutsky's Theorem, convergence in mean square, limiting variance, convergence in distribution, weak law of large numbers, central limit theorems

- Non-spherical disturbances – heteroscedasticity, autocorrelation, Zellner's Theorem, FGLS estimators, panel models, time-series cross-section models, White estimator, quasi-differencing, Newey-West estimator, SUR estimator
- Endogenous regressors – predetermined, strict exogeneity, weak exogeneity, strong exogeneity, structural equation, reduced form, IV estimator, ILS, quasi-instrumental variable, measurement error (basics and extensions), rank and order conditions, identification, 2SLS, 3SLS, proxy variables, Hausman test
- Maximum likelihood estimators – iid, density function, cdf, likelihood function, Cramer-Rao Theorem, information matrix, properties, log-likelihood function, dynamic factorization theorem, probit and logit for dichotomous, ordered, and unordered cases, random utility models, LR test, Wald test, LM test, truncated normal distribution, incidental truncation, hazard rate, Heckman two-step estimator, sample selection bias, censored normal distribution, Tobit model, marginal effects for truncation and censoring, Poisson regression with dispersion, truncation, and censoring, parametric and nonparametric duration models with censoring and truncation, survivor function, integrated hazard, state dependence versus heterogeneity, competing risks, split population models, strategic models
- Time series analysis – ACF, MA, AR, and ARMA processes, white noise, characteristic roots, eigenvalues, stationarity, ADL models, Mann-Wald Theorem, VAR, Granger causality, difference stationary, stochastic versus deterministic trends, trend stationary, nonstationary, unit root, cointegration, Grenander conditions, augmented Dickey-Fuller test, error correction model and estimation, fractional integration